



# United States Department of the Interior



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## Memorandum

To: Team Leader, Water Rights Acquisition Planning, Portland, Oregon  
(WRAP)

Refuge Manager, Stillwater National Wildlife Refuge, Fallon, Nevada

From: Field Supervisor, Reno Field Station, Reno, Nevada

Subject: Preliminary Natural Resource Survey for the Carson River Mercury Site, Nevada (NV ER91/938).

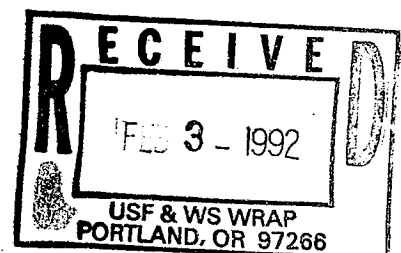
This memorandum transmits the Preliminary Natural Resource Survey (PNRS) for the Carson River Mercury Site in westcentral Nevada submitted to the Assistant Regional Director for Fish and Wildlife Enhancement on January 3, 1992, for transmittal to the Department of the Interior (Interior). The survey was conducted to determine if natural resources under the trusteeship of Interior have been affected by the release of hazardous substances at, or emanating from, the Superfund site. This report was prepared in support of the Environmental Protection Agency's (EPA) Superfund program under the provisions of an Interagency Agreement between the Fish and Wildlife Service and the EPA.

→ Please note that the PNRS is a confidential enforcement document which may be released only upon the approval by Interior and EPA. A memorandum to this effect is attached for your information.

If you have any questions, please contact Geoffrey A. Ekechukwu at FTS 470-5227.

David L. Harlow

Attachments





# United States Department of the Interior

OFFICE OF THE SECRETARY  
WASHINGTON, D.C. 20240



## Memorandum

OCT 18 1991

To: Director, Fish and Wildlife Service  
District Chief, WRD, Geological Survey, Boise, ID

From: Director, Office of Environmental Affairs

Subject: Preliminary Natural Resources Survey, Carson River Mercury Site,  
Lyon and Churchill Counties, NV ~~REF 91/938~~

The Environmental Protection Agency (EPA) has requested that the Department of the Interior conduct a preliminary natural resources survey (PNRS) to determine whether any natural resources under the trusteeship of this Department are or have been affected by hazardous substances releases at or from the Carson River Mercury Site, Lyon and Churchill Counties, NV.

Please conduct a PNRS pursuant to the EPA/DOI MOU. The Regional Environmental Officer (REO) in San Francisco, CA, will be establishing due dates for your comments when the current site information is provided by EPA. At that time, please consult with the REO and relevant State agencies to see what additional information is available, and prepare comments. The REO will prepare the survey report and forward it to headquarters for the Director's signature.

The site is now the subject of EPA enforcement actions. Please note that the PNRS results are also now enforcement confidential and may be released only upon the approval of this office and EPA.

The costs of the PNRS are reimbursable from EPA in accordance with the DOI/EPA MOU and the procedures of PEP Memo ER83-2. You are reminded that your cost estimates must be provided to the REO in advance, and your bill must be approved by the REO before you submit it through your administrative channels for reimbursement.

Jonathan P. Deason

cc:

Assistant Secretaries  
REO/SFN  
NPS  
GS

**Preliminary Natural Resource Survey  
Carson River Mercury Site, Nevada**

Prepared by

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December, 1991

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U.S. Fish and Wildlife Service  
Preliminary Natural Resource Survey  
Carson River Mercury Site  
December, 1991

FINDINGS OF FACT

**SITE EXPOSURE POTENTIAL**

Mercury contamination from the pre-1900 gold and silver mining operations on the Virginia Mountain Range and Washoe Valley, Nevada, has the potential to cause serious adverse biological effects on the Department of the Interior's (DOI) trust resources in the Carson River Mercury Site.

The U. S. Environmental Protection Agency (EPA) has described the Carson River Mercury Site as that portion of the Carson River basin that has been impacted by mercury (EPA, 1991). The EPA also describes the site as including: "(1) sediments in an approximately 100-mile stretch of the Carson River in Lyon and Churchill counties, beginning between Carson City and Dayton and extending downstream through Lahontan Reservoir to Stillwater National Wildlife Refuge (NWR); and (2) tailing piles and sediments in Gold Canyon, Sixmile Canyon, and Sevenmile Canyon" (EPA, 1991). While these perhaps describe the most impacted areas of the site, the full extent of mercury contamination in the Carson River Mercury Site has not been determined (Ekechukwu, 1991, unpublished data). Additional work will be necessary to fully characterize the occurrence and geographic extent of mercury contamination in the Carson River and the adjoining areas. Such work would include Washoe Valley sub-unit of the Truckee River basin and Carson River basin downstream of Lahontan Reservoir. The expanded site description may be called the Comstock Lode Mercury Site, Nevada.

**SITE DESCRIPTION**

Carson River Basin The Carson River Mercury Site is comprised of the Carson River basin and Washoe Valley sub-unit of the Truckee River basin. The Carson River drainage basin lies in western Nevada, and eastern California, at the western edge of the Great Basin. This portion of the site is comprised of six (6) hydrographic sub-basins and one associated hydrographic sub-basin in Nevada (Ekechukwu and Maki 1982). It excludes most of the Carson River drainage in California. Five of the hydrographic sub-basins (Carson Valley, Eagle Valley, Dayton Valley, Churchill Valley, Carson Desert) are part of the Carson River basin; the sixth, White Plains, is the terminus of the Humboldt River basin and connects that drainage to the Carson Desert. The associated sub-basin, Packard Valley, is a tributary to Carson Desert, but not directly to the Carson River. The area covers approximately 3,699 square miles in Nevada. An additional 112 square miles of Carson Valley sub-basin is located in California, and is not included in this site description.

The Carson River basin is hydrologically dominated by the east fork, west fork and mainstem of the Carson River, which flows into Lahontan Reservoir. The Truckee Canal, which diverts Truckee River water at Derby Dam and flows into Lahontan Reservoir, is not considered part of the Carson River Mercury Site.

The east and west forks of the Carson River flow from their headwaters in California in a northerly direction into Carson Valley hydrographic sub-basin. Within the valley, water from both forks flow through complex irrigation and diversion systems (Ekechukwu and Maki 1982). East of Genoa, Nevada, the east and west forks unite to form the Carson River. The river continues north through Eagle Valley before turning northeast and passing through Brunswick Canyon. As the river emerges from Brunswick Canyon, it enters Dayton Valley where it turns east into Churchill Valley. Lahontan Reservoir dominates Churchill Valley and serves as the water storage facility for the Newlands Irrigation Project. The stored water is used in the downstream agricultural area of the Carson Desert sub-basin. Within Carson Desert, the water flows either south to Carson Lake or east through numerous canals to Carson Sink where it disappears by percolation and evaporation (Ekechukwu and Maki 1982).

The Carson Desert, known locally as Lahontan Valley, occupies a flat area of about 2,020 square miles. It is one of the largest basin-fill valleys in northern Nevada, and the terminus of the Carson River. During exceptionally high runoff years, it is also the terminus of the Humboldt River (Hoffman et al. 1990). Irrigation drainwater from the Newlands Project and the agricultural area of Carson Desert subsequently discharges into Carson Lake, Stillwater marsh area, or Carson Sink.

The Carson River drainage begins in the high Sierra Nevada mountains at elevations of 11,000 feet and flows to the Carson Desert at 3,800 feet above sea level. These high mountains exert a dominant influence on the climatic and hydrological characteristics of the basin. Storms moving west to east across the mountains drop their moisture on the west-facing slopes and mountain tops, creating an area of diminishing precipitation east of these mountains. Annual precipitation ranges from less than 6 inches in the Carson Desert to more than 30 inches at the headwaters.

Generally, the river flows perennially throughout most of its reaches. There are many perennial tributaries draining the east slope of the Sierra Nevada which, along with intermittent tributaries in the lower reaches, play vital roles in ground water recharge. The number of perennial tributaries decreases in a downstream direction. After Brunswick Canyon, no perennial surface flow reaches the Carson River; temporary surface flows occur during runoff following heavy rainfall or snowmelt.

Washoe Valley Washoe Valley hydrographic area is a sub-unit of the Truckee River basin. The area is comprised of approximately 81 square miles, of which nearly 53 square miles are mountainous, and the remaining 28 square miles are valley floor. Washoe Lake and Little Washoe Lake are both located in this valley floor. The valley lies in southern Washoe County and is centrally located between Carson City and the Reno-Sparks metropolitan area. In the

late 1800s, the mountainous western portion of Washoe Valley served as a source of log and timber for the prosperous Comstock Lode gold and silver mines in the nearby Virginia City area. Some of the ore-milling operations were located on the valley floor (Rush, 1967, page 4).

#### SITE HISTORY

High levels of mercury in the Carson River basin were discovered in the early 1970s when sampling conducted by U.S. Geological Survey (USGS) revealed elevated levels in sediment and water samples (Van Denburgh, 1973). These samples were collected downstream from major pre-1900 Comstock Lode milling sites located in the Carson River basin. Subsequent studies conducted by a number of researchers (Richins 1973; Richins and Risser 1975; Ekechukwu 1976; Cooper 1983; Cooper et al. 1985; and Hoffman et al. 1990) further substantiated the occurrence and geographic extent of mercury contamination in the Carson River, particularly upstream of Lahontan Reservoir. Some of these researchers documented the uptake, bioaccumulation and biomagnification of mercury in fish and other biota, in addition to its potential impacts on wetland habitats downstream of Lahontan Reservoir and Washoe Valley hydrographic area.

Mercury contamination in the Carson River basin is believed to have been caused by gold and silver mining activities in the pre-1900 Comstock Lode operations on the Virginia Mountain Range. During this period (1859-1900), mercury amalgamation was used in the processing of gold and silver ore, and a large quantity (estimated at 7,500 tons) of mercury was lost in the process. Mining in the Carson River basin began in 1850 when placer gold deposits were discovered in the Gold Canyon area. Throughout the 1850s, mining consisted of working placer deposits for gold and silver in Gold Canyon and Six Mile Canyon. These ore deposits became known as the Comstock Lode.

The initial ore discovered was very rich in gold and silver. Gold was more abundant in Gold Canyon while silver was more abundant in Six Mile Canyon (Smith 1943). The early mining methods concentrated on exposing as much of the lode as possible in wide trenches. Throughout 1859, ore was shipped to San Francisco for processing. Local ore processing began in 1860. Most major mines operated their own mills, but a number of private mills also existed. The initial ore processing techniques were slow, tedious, and inefficient; and a fair amount of experimentation, trial and error went into the development of an effective ore-processing procedure using mercury amalgamation. Refinements of ore-processing procedure were aimed primarily at increasing the speed of gold and silver recovery, and decreasing the amount of gold and silver discarded in tailing piles.

Prior to 1900, ore processing was primarily through the amalgamation of gold and silver with mercury usually imported from San Francisco. After crushing, the ore was placed in heated pans and treated with elemental mercury (Smith 1943). The resulting amalgam was separated from slurry, and the remaining ore was discarded in mill tailings.

The quantity of mercury that might have been lost through this process is difficult to estimate. It is even more difficult to estimate how much mercury

might have entered the Carson River drainage system. De Quille (1889) reported that monthly mercury losses exceeded 61,000 pounds. Smith (1943) estimated that, on the average, the loss of mercury exceeded one pound for each ton of ore milled. This means that approximately 14,000,000 pounds of mercury may have been lost in the Carson River basin. Prior to 1866, little effort was made to save tailings. The tailings were discharged directly to river drainages where they were carried downstream.

The number and locations of mills in the Comstock Lode district is difficult to determine (Smith, 1943). Mills were concentrated along Gold Canyon from Gold Hill to Dayton, Carson River basin from New Empire to Dayton, Six Mile Canyon and in Virginia City itself. Mills were also present to the west outside the Carson River basin at Washoe Valley. Smith (1943) states that in 1863, 75 mills were present in the Comstock region, with 19 in Virginia City and Six and Seven Mile Canyons, 35 in Gold Canyon between Gold Hill and Dayton, 12 on the Carson River itself between Empire and Dayton, and 9 in Washoe Valley, Steamboat Creek and Galena Creek. Ansari (1989) briefly described 186 mills that operated in the Comstock Lode district, including 45 along the Carson River between Empire and Dayton, 20 at Virginia City, 22 along Six Mile Canyon, 29 in Gold Canyon area, 10 at American Flat, 50 at Silver City, and 10 in Seven Mile Canyon.

## CHEMICAL HAZARDS

### Chemical Contaminants and Concentrations

Mercury contamination from the pre-1900 gold and silver mining operations in Carson River basin and Washoe Valley, Nevada, are the primary concern of this site. Several researchers (Van Denburgh 1973, Richins 1973, Richins and Risser 1975, Ekechukwu 1976, Cooper 1983, Cooper et al. 1985, and Hoffman et al. 1989) have documented high levels of mercury in water, sediment, plant and animal tissues collected from this site that exceed recommended threshold levels for public health and fish and wildlife propagation. As a result of these studies, the Nevada State Health Officer in 1987 issued public health warnings for fish consumption at popular fishing locations in the Carson River basin, particularly at Lahontan Reservoir and downstream of that site. Again in 1989, the State Health Officer posted another public health advisory at Carson Lake specific to shoveler duck consumption.

In recent years, few studies have been conducted to determine the extent of mercury contamination in the Carson River basin and Washoe Valley. It was not until 1971 that the USGS collected samples of water and sediment from the Carson River basin for mercury analysis (Van Denburgh 1973). The studies indicate that background mercury levels in the upper 7 cm of sediment upstream from pre-1900 milling sites on the Carson River were 0.1 micrograms per gram (g/g). Downstream sediment mercury concentrations were measured up to 200 times background (20 g/g). The highest sediment mercury concentrations were found just upstream from the Lahontan Reservoir. The highest mercury concentration in water was 2.72 g/l from samples collected from Lahontan Reservoir.



Richins (1973) and Richins and Risser (1975) were the first to document that aquatic organisms in the Carson River basin contained levels of mercury in muscle tissues which exceeded concentrations considered safe by the U.S. Food and Drug Administration (FDA). The study found that mercury concentrations in aquatic organisms increased downstream from early Comstock Lode milling sites (Cooper et al. 1985). In 200 fish samples, representing seven species collected from the Lahontan Reservoir, total mercury concentrations ranged from 0.02 to 2.72 g/g wet weight. Ekechukwu (1976) found that mercury levels in carp fillets Cyprinus carpio, taken below Lahontan Reservoir ranged from 5.0 to 11.5 g/g wet weight. This study demonstrated that Lahontan Reservoir is not the ultimate sink for mercury in the Carson River basin. This conclusion was substantiated by Hoffman et al. (1990).

In 1970, the FDA analyzed for mercury in six fish samples collected from Newlands Irrigation Project below Lahontan Reservoir. These fish included white bass Morone chrysops (3.2 g/g), white catfish Ictalurus catus (3.0 g/g), largemouth bass Micropterus salmoides (1.6 g/g), rainbow trout Salmo gairdneri (1.3 g/g), yellow perch Perca flavescens (0.97 g/g), and black bullhead Ictalurus melas (1.1 g/g). All of these samples exceeded FDA recommended criterion for public health. Studies conducted by Desert Research Institute (Cooper 1983; Cooper and Vig 1984) also found elevated mercury levels in fish muscle tissues. The studies indicated that mercury concentrations in these tissues collected from 11 species of fish ranged from 0.11 in young white bass Morone chrysops to 9.52 g/g in a striped bass Morone saxatilis, with known residence time of 16 years in Lahontan Reservoir. Of the 53 muscle tissue samples analyzed, 36 (68%) exceeded the 1.0 g/g "action level" considered safe by FDA. Heart tissue samples ranged from 0.17 g/g to 5.58 g/g. Liver tissue was expectedly higher than heart and muscle tissues which ranged from 0.21 g/g in brown bullhead Ictalurus nebulosus to 23.65 g/g in striped bass. There was evidence of biomagnification of mercury between fish species in different trophic levels.

The most recent and comprehensive work on mercury contamination in the Carson River basin below the Lahontan Reservoir was conducted by Hoffman et al. (1990) under the DOI's Irrigation Drainwater Program. This study indicates that dissolved mercury in water ranged from less than 0.1 g/l to 1.1 g/l. Of the 47 water samples analyzed, 27 or 57% had concentrations of dissolved mercury that were at or above the analytical reporting limit, thus exceeding the Nevada single value criterion of 0.05 g/l for the propagation of wildlife, but well below the aquatic life criterion of 4.1 g/l (Hoffman et al. 1990). The highest concentrations of dissolved mercury were found in water samples from Lead Lake (1.1 g/l) in May 1987 and from Stillwater Point Reservoir (0.9 g/l) in September 1986. Because of the high affinity of mercury for particulate organic matter, high concentrations of mercury in filtered water samples were not expected.

In sediment samples, mercury levels ranged from 0.04 to 18 milligrams per kilogram at sites affected by irrigation drainage (Hoffman et al. 1990). The highest concentration of mercury (18 mg/kg) was found in bottom sediments from Carson Lake. Bottom sediments from Stillwater Slough, an old channel of Carson River, had a mercury concentration of 14 mg/kg. These values are

44-fold and 34-fold greater respectively, than the median background concentration (0.41 mg/kg). A moderately high concentration of mercury (0.67 mg/kg) also was found in sampled bottom sediments from Washoe Lake, which was used as a background site for this study.

Biological samples showed varying concentrations of mercury with strong evidence of bioaccumulation and biomagnification through the food chain. Within the wetland units in the Carson River below Lahontan Reservoir, 102 composite plant and plant part samples were analyzed for mercury (Hoffman et al. 1990). Of these 102 samples, five from Carson Lake and seven from Stillwater Wildlife Management Area (WMA) exceeded the dietary effect level of 0.39 g/g dry weight total mercury or 0.36 g/g methylmercury. Among plants sampled from the drains, Potamogeton sp. in Carson Lake Drain at Carson Lake (median 6.0 g/g) and TJ Drain in Stillwater WMA (median 2.0 g/g) were unusually high in mercury. Of the 17 plant and plant parts analyzed from Carson Valley and Washoe Lake, mercury concentrations were reported below the analytical reporting limit.

Suitable criteria for evaluating the significance of mercury residue in invertebrate tissue are not available. The dietary criterion of 0.39 g/g mercury dry weight was used as a guide (Heinz, 1979, p. 395; Eisler, 1987, p. 74). This criterion was regularly exceeded in composite samples of insects. Carson Lake wetland units and associated input drains were notable in regard to mercury concentrations. All of the nine samples analyzed exceeded 1.0 g/g dry weight. The highest concentration was 5.4 g/g dry weight in the Sprig Pond Unit of Carson Lake. Concentrations of mercury in insects from the Carson Valley background site, Massie and Mahala Slough, Fernley WMA and Humboldt WMA were less than 0.5 g/g. There is no history of mercury contamination in these areas.

Carp and mosquito fish from Carson Lake contained relatively high levels of mercury (1.0 to 2.0 g/g dry weight). One Sacramento perch Archoplites interruptus taken from Sprig Pond in Carson Lake, had a whole body residue level of 5.70 g/g mercury and one smallmouth bass Micropterus dolomieu taken from Alkali Unit no. 1 in Stillwater NWR, had a whole body residue level of 2.1 g/g dry weight. Three white bass (Morone chrysops) from Harmon Reservoir contained a median whole-body mercury level of 4.8 g/g dry weight (range 1.4 to 5.26 g/g). Carp from Washoe Lake contained high levels of mercury. The median whole-body concentration was 3.7 g/g dry weight.

The public health warning for mercury in edible bird tissue, 3.6 g/g dry weight, was exceeded in duck muscle and in duck and coot liver. The median concentration of mercury in mallard muscle was 4.4 g/g in Carson Lake. Mercury residue in muscle of redheads and shovelers was consistently less than 3.6 g/g dry weight. As expected, duck liver contained the highest residue levels. Some of the highest mercury levels in liver were found at: Sprig Pond Unit in Carson Lake (12.0 g/g); West Lee Drain at Carson Lake 2.0 g/g; the Island Unit in Carson Lake (6.5 g/g); and Lead Lake in Stillwater WMA (4.5 g/g). Liver residue in redheads and shovelers (3.6 and 6.1 g/g) from Lead Lake in the Stillwater WMA were exceptionally high.

## TRUST RESOURCES

### Threatened and Endangered Species

#### Plants

No federally listed endangered or threatened plant species occur in the Carson River Mercury Site. However, two category 2 candidate species are found in potentially contaminated areas. A candidate species is a species which the U.S. Fish and Wildlife Service (Service) is considering listing as either endangered or threatened species. A category 2 candidate comprises taxa for which information now in possession of the Service indicates that proposing to list as endangered or threatened is possibly appropriate. Altered andesite buckwheat (Eriogonum lobbii var. robustum) has been identified in the vicinity of Virginia City, Six Mile and Seven Mile Canyons in Virginia Range. Nevada Oryctes (Oryctes nevadensis) has been documented in several areas below Lahontan Reservoir. Other ecologically sensitive plants found in the area include Opuntia pulchella, which has been identified in several locations below Lahontan Reservoir; Camissonia nevadensis, found near Empire and Soda Lake, and soft leaf lupine (Lupinus malacophyllus), which occurs approximately 1 mile south of Dayton, Nevada.

#### Invertebrates

Two category 2 candidate invertebrate species, wandering skipper (Pseudocopaeodes enus enus) and Mono checkerspot butterfly (Euphydryas editha monoensis), have been identified in areas adjacent to the Carson River Mercury Site.

#### Fish

Cui-ui (Chasmistes cujus), an endangered species and Lahontan cutthroat trout (LCT), (Oncorhynchus clarki henshwi), a threatened species, that inhabit the Truckee River basin could potentially be impacted by mercury contamination from the Washoe Valley hydrographic sub-basin (James Cooper, oral communication 1991). LCT historically occurred in the lower Carson River basin, but has not been reported in the area recently, especially since the Comstock Lode milling operations. The introduction of non-native trout before the turn of the century is probably responsible for the extirpation of LCT in the Carson River basin (McAfee 1966). The extirpation may have been accelerated by a combination of upstream agricultural water uses, habitat loss and habitat degradation (Chester Buchanan, oral communication 1991).

#### Birds

The lower Carson River and the terminal marsh provide wintering habitat for up to 70 bald eagles (Haliaeetus leucocephalus), which are listed as endangered by both the United States and the State of Nevada. Washoe Lake supports a wintering waterfowl population of up to 500 individuals (Norm Saake, oral communications 1991). The American peregrine falcon (Falco peregrinus anatum), also listed as an endangered species by United States and State of Nevada, has been identified in the vicinity of Carson City and eastern Sierra

Nevada mountains. The ferruginous hawk (Buteo regalis), a category 2 candidate species, occurs in northern Churchill County, and may periodically occur in this mercury contaminated site. Long-billed curlew (Numenius americanus) and white-faced ibis (Plegadis chihi) are also found along the Carson River, but are most abundant in the terminal marsh areas of the basin. Carson Lake supports the largest breeding colony of white-faced ibis in North America. Snowy plover (Charadrius alexandrinus nivosus) has been identified as uncommon and mountain plover (Charadrius montanus) has been identified as rare in the lower Carson River (Anne Janik, personal communication 1991).

#### **Mammals**

The Sierra Nevada red fox (Vulpes vulpes necator), a category 2 candidate species, has been identified in the eastern slopes of the Sierra Nevada and in the vicinity of Carson City.

#### **Migratory Birds**

Wetland, riparian, and upland habitats in mercury contaminated areas support up to 206 species of birds, most of which are migratory birds (Anne Janik, oral communication 1991). Wetland areas at the terminus of the Carson River, especially Carson Lake and Stillwater NWR, have been identified as important stops on the Pacific Flyway, and serve as significant production areas for some species. These areas have annually supported more than 250,000 waterfowl, including 12,000 tundra swan, 25,000 canvasback, and 20,000 redheads (Thompson and Merrit, 1988). Over 30,000 white pelican have also been recorded in these wetland areas. Shallow marsh areas in the lower Carson River basin are also important to shorebirds. This area has been designated as one of 13 Western Hemispheric Shorebird Reserves.

About 24 raptor species, including the endangered bald eagle and peregrine falcon, occur in Washoe Valley and the lower Carson River basin. These birds may be exposed to mercury contamination through the food chain.

#### **Other Species of Concern**

##### **Fish**

Six fish species historically occurred in the lower Carson River basin and Washoe Valley. Sixteen non-native species have become established in potentially contaminated areas. Several species are planted by Nevada Department of Wildlife to provide a warm water sport fishery. One species, Sacramento blackfish (Orthodon microlepidotus) is harvested commercially.

##### **Amphibians and Reptiles**

Eleven amphibian species, including 2 salamanders, 3 toads, 6 frogs, and 36 reptilian species, including 1 turtle, 13 lizards, and 22 snakes, have been identified in west-central Nevada (BLM 1974). Species diversity and abundance are low in the most contaminated areas of the basin.

#### **Mammals**

Approximately 50 mammalian species occur in the Carson River Mercury Site. Scavengers and higher trophic level predators include 9 bat species, 6 mustelids including mink (Mustela vison) and possibly river otter (Lutra spp.), raccoon (Procyon lotor), coyote (Canis latrans), kit fox (Vulpes macrotis), mountain lion (Felis concolor), bobcat (Lynx rufus), and black bear (Ursus americanus).

#### Potential Pathways of Contaminants to Impact Trust Resources

Potential pathways of mercury to impact DOI trust resources on or near the Carson River Mercury Site include airborne movements of contaminated soils and disposed operational wastes, leaching of soluble contaminants into ground water, plant uptake through contaminated soils, consumption of contaminated plants by fish and wildlife, and direct exposure and ingestion of contaminated water by fish and wildlife. Migratory birds and threatened and endangered species (e.g. bald eagle and peregrine falcon) could potentially be exposed to contaminants through direct ingestion of contaminated food from the Carson River Mercury Site and the associated wetland habitats, such as the Stillwater NWR and Lahontan Valley wetlands. Exposure would primarily occur through consumption of contaminated food chain items such as invertebrates, fish, waterfowl, and small mammal. These organisms could accumulate toxic mercury directly or indirectly by being exposed to the pollutant on the site.

#### CONCLUSIONS

Based on mercury concentrations measured in water and biota collected from the site, both direct and indirect adverse effects may be predicted in migratory birds, fish and the ecosystem as a whole in the Carson River Mercury Site. Public health advisory for mercury has been posted by the State of Nevada Division of Health against eating fish from the Lahontan Reservoir, Carson River below Lahontan Reservoir and all waters in Lahontan Valley. A similar advisory has been posted for eating shovelers collected from the Carson Lake.

The Carson River water and irrigation drainage water from the Newlands Project area flow into Stillwater NWR and associated wetland habitats in Lahontan Valley. These wetland habitats are important to numerous species of fish and migratory birds that utilize the Pacific Flyway. The Stillwater NWR is one of the 13 Western Hemispheric Shorebird Reserves. Migratory birds use the area during winter and migration seasons, and a few species nest and raise their young on the site, particularly the wetland habitats downstream of Lahontan Reservoir. Several species of raptors, including bald eagles, are known to forage in the area. Many of the DOI trust resources are exposed directly to toxic methylmercury compounds in water and sediments, or indirectly by feeding on materials and organisms already exposed to mercury contamination. Hoffman et al. (1990) has demonstrated the bioaccumulation and biomagnification of mercury in biota collected from downstream of Lahontan Reservoir. Sample analysis indicates the occurrence of mercury in sediments collected from old river channels of Carson River downstream of Lahontan Reservoir. Mercury has been mobilized and transported through the food chain in lower Carson River basin. In particular, uptake of mercury with arsenic, selenium, boron, zinc,

and other contaminants identified in Stillwater NWR and vicinity may, singly or in combination, accelerate adverse biological effects of mercury to fish and wildlife.

Without further investigations, including sampling of biological resources both on and off the site, to determine that contaminants are not accumulating in animal tissues through the food chain, we could not consider agreeing to a covenant not to sue for natural resources damage claims at this time. However, should timely remedial action resulting from detailed remedial investigation and feasibility studies ensure that surface water and ground water flows from the site are not affecting our trust resources, we would reconsider our position.

#### RECOMMENDATIONS

The Service recommends a more comprehensive delineation of the Carson River Mercury Site to include Carson River basin and the associated wetland habitats downstream of Lahontan Reservoir. The site also should include the Washoe Valley unit of the Truckee River hydrographic basin, because it has been linked to mercury contamination resulting from the pre-1900 Comstock Lode operations. Washoe Valley is an important functional unit of Lahontan Valley wetland habitats.

The Service further recommends that an extensive remedial investigation and feasibility study be conducted on the Carson River Mercury Site. Water and soil analyses are insufficient tools to characterize the problem. Additional evaluations of soil, water, sediment, invertebrates, fish, birds (including blood), algae, and other plants should be conducted to determine the full extent of mercury contamination. The majority of sampling efforts thus far has focused on Carson River from New Empire to Lahontan Reservoir, and even at that, the level of effort is insufficient to define the scope and extent of contamination. Recent studies by the DOI have emphasized the effects of agricultural drainwater on water quality, sediment, and biota downstream of Lahontan Reservoir. This reconnaissance study of water quality, sediments and biological samples indicate that mercury contamination exists in Carson River below Lahontan Reservoir. Cooper et al. (1985) demonstrated similar contamination in Washoe Valley, Nevada.

More extensive sampling should be conducted in the milling site areas to determine the true extent of mercury contamination. These milling disposal areas have been closed for many years, and are known to erode contaminated soil and sediments to Carson River. A thorough investigation of potential ground water contamination should be conducted, including investigation of ground water entering the Carson River, Washoe Lake, and Little Washoe Lake.

Airborne transport of contaminated soil particles is unlikely to present a significant hazard to the DOI trust resources. However, some epidemiologic work on humans may be conducted to extrapolate the potential for airborne mercury contamination in terrestrial animals.

We recommend that analyses of soil, water, sediment, and biological samples be included as important elements of the remedial investigation and feasibility

study to determine if aquatic organisms are accumulating toxic mercury through the food chain. Biological samples should be collected from the entire Carson River Mercury Site which includes all of Carson River basin and the associated wetland habitats, and Washoe Lake and Little Washoe Lake in Washoe Valley. Concentrations in biological tissues should be compared to ambient concentrations to determine evidence of biomagnification through the food chain.

We recommend that the Service be informed of all activities about this site, including but not limited to, work plans, studies, data evaluations, and negotiations on remedial actions. The Service should continue to be given the opportunity to participate in the Technical Advisory Committee for the Carson River Mercury Site so that study designs, consultant products, and recommended remedial actions would reflect full consideration for the protection of Service trust resources. The remediation phase must involve the full participation of the Service.

#### DISCLAIMER

Recommendations or releases resulting from the Preliminary Natural Resources Survey do not deal with or compromise the ability of the United States to prosecute civil or criminal violations of the laws or regulations which may be caused by or result from actions of persons or entities involved in the activities which are the subject of this survey. Further, it should be clear that any other remedies, including monetary damages, for violations of the law or contract provisions existing between the United States and any entity concerned in activity which is the subject of this survey are neither considered or waived.

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